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Forecasting septoria in England and Wales V: the 1979 forecast

by N Thompson

1. Introduction

In earlier papers in this series regional Septoria disease levels (percentage infection on leaf 2 as measured in the National Cereal Leaf Disease Survey) were related principally to numbers of wet days (days with rainfall $\geq$ 1 mm) in the latter half of May and the first half of June. This provided a very simple disease forecasting scheme which could be refined (but only slightly) by taking account of the slight correlation with the previous year's infection and a small (negative) correlation with the amount of bright sunshine, expressed as a percentage of average.

Table 1 gives the simple forecast scheme. The forecast is modified

Table 1 The basic forecasting scheme

(a) SW, SE, W. Mid, Wales

No. of wet days 2nd half of May	≤ 3	4	≥ 5
Forecast infection per cent	< 10 (slight)	10-20 (moderate)	> 20 (severe)

(b) E. Mid, E, Y/L, N

No. of wet days 2nd half of May	≤ 3	4 or 5	≥ 6
Forecast infection per cent	< 5 (slight)	5-20 (moderate)	> 20 (severe)

down by one category (ie severe becomes moderate) if the first half of June has two or less wet days. The relation between wet days and infection is clearly non-linear, but if linearity is assumed then a linear multiple regression analysis taking all regions together (Tyldesley and Thompson 1980) which includes also the previous year's infection (I_1) and the amount of bright sunshine (S) in period 16 May - 15 June, expressed as a percentage of average, leads to the relation

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$$I = 1.5 + 4.2W + 0.34I_1 - 0.033WS \qquad (r = 0.78) \qquad (1)$$

: here I is the percentage infection and W is the number of rain days in the period 16 May - 15 June.

These forecasting methods were developed using data from the years 1970-75, and since then only 1979 has been a "Septoria year" (ie with substantial levels of disease). In the low disease years 1976-78 (8 regions x 3 years = 24 cases) the forecast based on rain days **alone** was correct in 17 cases and more than 1 category wrong in only 2 cases, both of which occurred in 1976 when the weather was very different from the years providing the data from which the forecast method was developed. The remainder of this paper will describe the performance of the simple method and that using Eq (1) in 1979.

2. Data and the forecast for 1979

Table 2 lists values for both dependant and independant variables for this year, both regionally and nationally. The basic forecasting scheme (Table 1)

Table 2 1979 data

Region	I	I_1	W_{2M}	W_{1J}	W_{2J}	S_{2M}	S_{1J}	S_{2J}
SE	25.0	3.6	9.6	5.6	3.4	101	51	95
SW	11.6	2.7	11.4	4.9	2.6	95	59	95
W.Mid	16.2	8.9	10.0	5.5	2.4	93	60	113
Wales	9.0	3.5	8.7	3.3	2.5	93	59	117
Averages	15.5	4.7	9.9	4.8	2.7	95	57	105
E	10.9	5.7	8.6	4.6	2.4	109	66	103
E.Mid	10.3	6.9	10.3	3.7	1.7	98	72	105
Y/L	2.0	1.1	10.3	3.0	3.3	93	75	111
N	0.4	2.5	10.5	5.5	3.5	91	73	119
Averages	5.9	4.1	9.9	4.2	2.7	98	71	109
Overall Averages	10.7	4.4	9.9	4.5	2.7	97	64	107

Notes: Suffix 2M last half of May
1J first half of June
2J last half of June

predicted severe infection in all regions and the regression equation indicated a mean level of infection of 30.4%, compared to the 10.7% which was observed. Looking at the regional values individually, in only the South-East was there severe infection. However the forecast was only 1 category wrong for 4 of the remaining 7 regions and in only Yorks/Lancs and the North Region was it completely misleading. The remainder of this paper considers reasons for differences between observed and forecast levels of infection.

3. Discussion

Inherent in the simple forecasting scheme is the idea that in late May and early June the crop is at growth stages which are particularly vulnerable to the spread of infection. However it is well known that the development of plants will be accelerated or retarded by unusually warm or cold weather and it is probable that the simple forecast scheme will only work well when the "season" is close to average in terms of temperature. In other years it would appear to be more appropriate to count rain days over a period starting at a time determined by the growth stage of the crop (approximately stage 6, the start of elongation) rather than at a fixed calendar date. The spring in 1979 was unusually cool and was followed by a cool June and these led to rather retarded crops. A rough indicator of the stage of development of plants is the accumulated temperature in day degrees, measured above a suitable base, with the calculations starting from a date before which growth is very slow. Cereals grow slowly even at temperatures very close to 0 deg C, but because growth is much more rapid at higher temperatures a convenient base temperature has been assumed to be 4 deg C in the following discussion (very similar results are obtained using a base temperature of 6 deg C). A suitable starting date for the accumulation is the beginning of March.

Table 3 shows the extra period in days required in 1979 to accumulate the number of day-degrees above 4 deg C in March, April and May in an average year. Clearly the spring was very late in the West and North. A further consideration

Table 3 Lateness of season at end of spring in 1979

Region	Lateness in days
SE	5
SW	10
W. Mid	6
Wales	11
E. Mid	4
E	4
Y/L	9
N	10

is the long-term variation of season across the country. Figure 1 gives iopleths of accumulated day degrees above 4 deg C for March-May, for 1979 and also for longer term data (roughly 20 years). It is seen that in the long term the north lags the south by around 100 day degrees, or by about 11 days. The present forecasting scheme takes no account of this. In an average year the March-May accumulation of day degrees averaged over all regions is about 460, close to the figure for Wales, East and West Midlands and East Region. The South-East and South-West exceed this by 40-70 (equivalent to 4-7 days accumulation) and Yorks/Lancs and North Regions fall short by about 40-70 (5-8 days). On the assumption that the forecasting method is tuned to the "average" season with 460 day degrees, then the variation of season, region-by-region, in 1979 compared to this average may be calculated (Table 4).

On this basis the start of the count of rain days should have been delayed

Table 4 Days after end of May in 1979 to reach 460 day degrees

Region	Extra days
SE	0
SW	3
W. Mid	7
Wales	11
E. Mid	5
E	5
Y/L	12
N	17

to the end of May or the beginning of June in Wales, Yorks/Lancs and North Regions, and this would have changed the forecast category to close to the observed disease levels in the first two regions. In the North Region in particular many crops were sown late during the previous autumn in poor seed beds and their late establishment followed by a hard winter resulted in a very backward crop at the start of spring, and late tillering. For this region the count of rain days should have begun even later than indicated in Table 4, with a resulting forecast infection closer to that observed.

4. Concluding remarks

It has been demonstrated that good forecasts for amounts of disease in 1979 are obtained from the simple forecasting scheme provided account is taken of the delay in crop development (as indicated by accumulated day degrees above a base of 4 deg C for the spring period) caused by the cold spring. It is suggested that future forecasts might make an allowance for variations of crop development from year to year, and between regions, by counting rain days in the 14 day period ending when a day degree accumulation of about 460 (base 4 deg C) from 1 March is reached.

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Any comments or suggestions on this paper should be referred to the author.

Meteorological Office Met O 8a
London Road
Bracknell
Berkshire

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Reference

Tyldesley J B and Thompson N 1980 Submitted to Plant Pathology

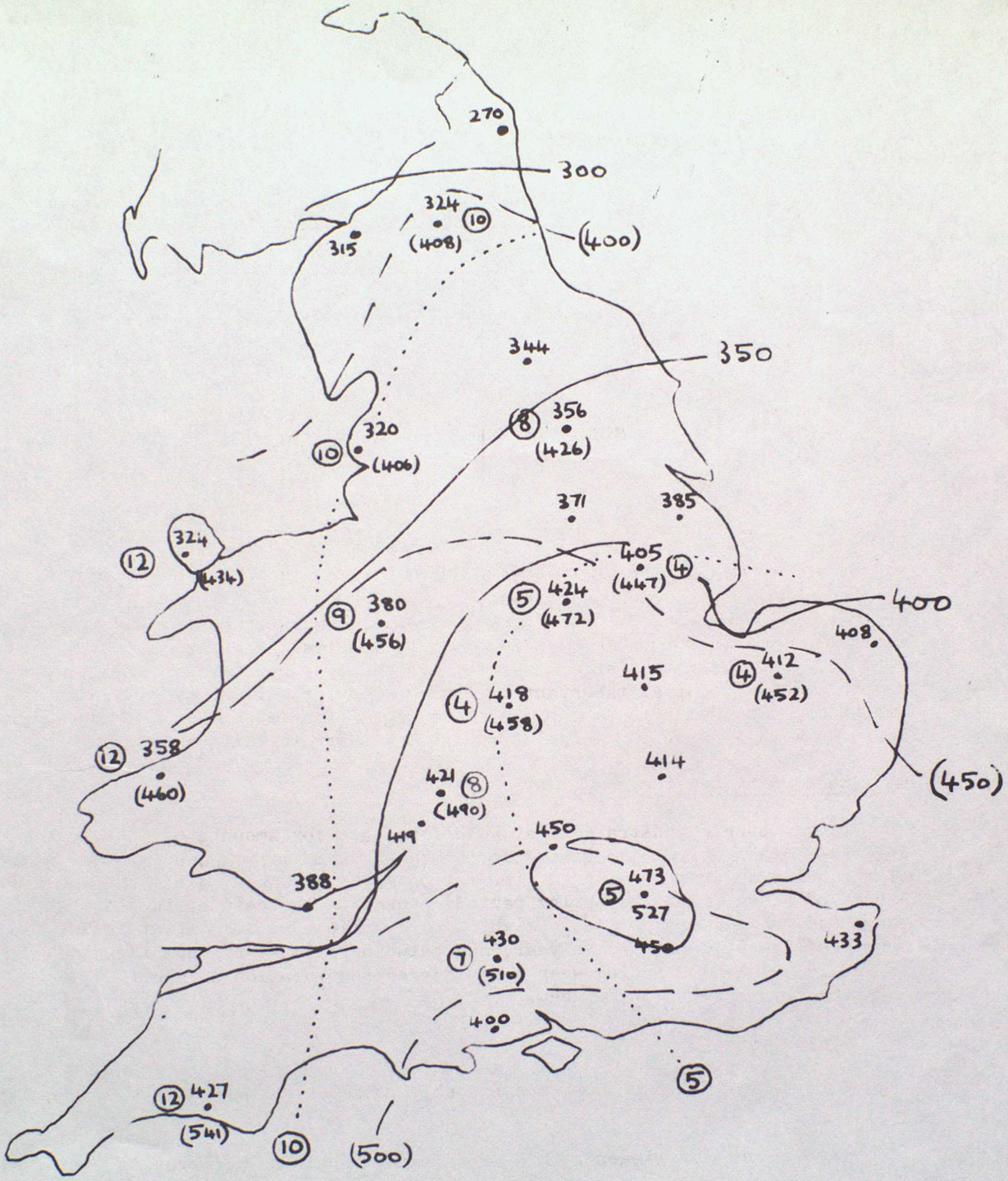

Figure 1 Sea-level isopleths of day-degree accumulations above 4 deg C for March, April and May

——— 1979

– – – – – Long-term average (numbers in brackets)

..... difference (in days) of 1979 from long-term average